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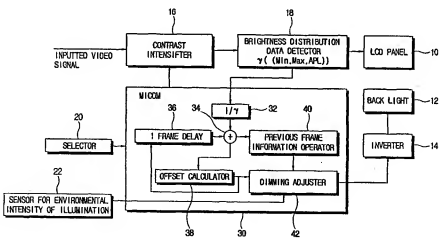
(54) Title: DISPLAY AND CONTROL METHOD THEREOF



(57) Abstract: A display including a liquid crystal display panel, a back light, an inverter to supply electric power to the back light and adjust an intensity of illumination of the back light, a selector to select a function to adjust the intensity of the illumination of the back light, a brightness distribution data detector to detect the brightness distribution data of the inputted video signal, a sensor to sense the environmental intensity of illumination, and a controller to determine the lightness of an image based on at least one of the environmental intensity of illumination sensed by the sensor for an environmental intensity of illumination and the brightness distribution data detected by the brightness distribution data detector according to the selector and to control the inverter to adjust the intensity of illumination of the back light according to the determined lightness.

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DISPLAY AND CONTROL METHOD THEREOF

FIELD OF THE INVENTION

The present invention relates to a display in which an intensity of illumination of a back light is automatically adjusted according to a brightness of at least one of an intensity of illumination of environment and brightness distribution data of an inputted video signal as a selection of a user to provide the most suitable image and control method thereof.

BACKGROUND ART

Generally, a display is used to display a video signal inputted from a video card and the like. The display is classified into a light emitting type and a light receiving type.

A cathode ray tube (CRT), a plasma display panel (PDP), and the like, are the light emitting type, so that images are displayed by emitting light.

In contrast, a liquid crystal display (LCD) utilizes two facing substrates with a liquid crystal material between them that is in a state that is sort of like a liquid and sort of like a solid. The LCD displays an image using an electro-optic property of the liquid crystal whose molecular arrangement is varied according to an electric field. Here, the LCD is a passive display that does not emit its own light, such that the LCD requires an external

light source to emit light by itself. A back light is generally used as a surface light source for the LCD to uniformly maintain brightness through the screen of the LCD.

Conventionally, the LCD has a button for a user to adjust the lightness of a displayed image and the lightness of the back light, as desired.

However, in the conventional LCD, characteristics of an image (for example, contrast of light and darkness) vary according to an intensity of the environment or the brightness of a inputted video signal. Thus, the user should adjust the lightness of the back light to compensate, which may limit image quality.

DISCLOSURE OF INVENTION

Accordingly, the present invention has been made keeping in mind the above-described shortcoming and user's need, and an object of the present invention is to provide a display in which an intensity of illumination of a back light is automatically adjusted according to a brightness of at least one of an intensity of illumination of environment and brightness distribution data of an inputted video signal as a selection of a user to provide the most suitable image and control method thereof.

Additional aspects and/or advantages of the invention will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the invention.

The foregoing and/or other aspects of the present invention are achieved by providing a control method of a display comprising: an LCD panel; a back light to illuminate the LCD panel; an inverter to supply electric power to the back light and adjust an intensity of illumination of the back light, the control method of the display comprising: sensing an environmental intensity of illumination; detecting a brightness distribution data of an inputted video signal; determining lightness of an image based on at least one of the sensed environmental intensity of illumination and the detected brightness distribution data of the inputted video signal, when a function to adjust the intensity of illumination of the back light according to at least one of the environmental intensity of illumination and the brightness distribution data of the imputed video signal is selected; and controlling the inverter to adjust the intensity of the illumination of the back light according to the determined lightness.

According to an aspect of the invention, the control method of a display further comprises detecting the brightness distribution data by intensifying a contrast of the inputted video signal to a predetermined gain.

According to an aspect of the invention, the control method of a display further comprises: controlling a contrast intensifying gain to decrease and the intensity of illumination of the back light to decrease, if the

controller determines that the inputted video signal is dark based on the brightness distribution data detected by the brightness distribution data detector, and controlling the contrast intensifying gain to increase and the intensity of illumination of the back light to decrease to a predetermined level, if according to an aspect of the invention the controller determines that the inputted video signal is dark.

According to an aspect of the invention, the control method of a display further comprises: controlling the inverter to decrease the intensity of illumination of the back light, if determined that the environmental intensity of illumination is low and controlling the inverter to increase the intensity of illumination of the back light, if determined that the environmental intensity of illumination is high.

According to an aspect of the invention, the control method of a display further comprises: controlling the inverter to decrease the intensity of illumination of the back light, if determined that the inputted video signal is dark based on the detected brightness distribution data and controlling the inverter to increase the intensity of illumination of the back light, if determined that the inputted video signal is light.

The foregoing and/or other aspects of the present invention are also achieved by providing a display

comprising: an LCD panel; a back light to illuminate the LCD panel; an inverter to supply electric power to the back light and adjust an intensity of illumination of the back light; a selector to select a function to adjust the intensity of illumination of the back light according to at least one of an environmental intensity of illumination and brightness distribution data of an inputted video signal; a brightness distribution data detector to detect the brightness distribution data of the inputted video signal; an sensor for an environmental intensity of illumination to sense the environmental intensity of illumination; and a controller to determine the lightness of an image based on at least one of the environmental intensity of illumination sensed by the sensor for an environmental intensity of illumination and the brightness distribution data detected by the brightness distribution data detector according to a selection through the selector and control the inverter to adjust the intensity of illumination of the back light according to the determined lightness.

According to an aspect of the invention, the display further comprises a contrast intensifier to intensify a contrast of the inputted video signal to a predetermined gain and supply the intensified contrast to the brightness distribution data detector.

According to an aspect of the invention, the controller controls the contrast intensifier to decrease a

contrast gain and the inverter to decrease the intensity of illumination of the back light, if the controller determines that the inputted video signal is dark based on the brightness distribution data detected by the brightness distribution data detector, and the controller controls the contrast intensifier to increase a contrast gain and the inverter to decrease the intensity of illumination of the back light to a predetermined level, if the controller determines that the inputted video signal is bright.

According to an aspect of the invention, the controller controls the inverter to decrease the intensity of illumination of the back light, if the controller determines that the environmental intensity of illumination is low based on the sensing signal sensed by the sensor for an environmental intensity of illumination, and, the controller controls the inverter to increase the intensity of illumination of the back light, if the controller determines that the environmental intensity of illumination is high.

According to an aspect of the invention, the controller controls the inverter to decrease the intensity of illumination of the back light, if the controller determines that inputted video signal is dark based on the brightness distribution data detected by the brightness distribution data detector, and the controller controls the inverter to increase the intensity of illumination of the

back light, if the controller determines that the inputted video signal is light.

Additional aspects and/or advantages of the invention will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

These and/or other aspects and advantages of the present invention will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings of which:

FIG. 1 is a block diagram of a display according to an embodiment of the invention;

FIG. 2 is a graph illustrating intensified contrast levels of a contrast intensifier in FIG. 1;

FIG. 3 is a graph illustrating an intensity of illumination of a back light according to a duty ratio of a pulse width modulation signal;

FIG. 4 is a flow chart of a display according to the embodiment of the invention; and

FIG. 5 is a flow chart of a display according to a second embodiment of the invention.

MODES FOR CARRYING OUT THE INVENTION

Hereinafter, preferred embodiments of the present invention will be described in more detail with reference

to the accompanying drawings.

As shown in FIG. 1, a display according to an embodiment of the present invention comprises an LCD panel 10, a.

The MICOM 30 comprises a gamma inverter 32 to inverse the brightness distribution data detected by the brightness distribution data detector 18, an offset calculator 38 to calculate an offset between present brightness distribution data and brightness distribution of the previous frame, a previous frame information operator 40 to set a suitable value for a brightness distribution data of the previous frame according to a brightness distribution and a dimming adjuster 42 that considers the suitable value for a brightness distribution data of the previous frame corresponding to a brightness distribution set by the previous frame information operator 40 and the offset calculated by the offset calculator 38 and calculates a dimming adjusting value according to present brightness distribution data to output an analog or a PWM dimming signal to the inverter 14.

The dimming adjuster 42 outputs a corresponding analog or a corresponding PWM dimming signal based on a sensed signal of the sensor for an environmental intensity of illumination to the inverter 14.

With the above configuration, the display according to a first embodiment of the present invention is controlled

as shown in FIG. 4.

If a brightness adjusting function selecting signal for the back light 12 according to a environmental intensity of illumination is input at operation 100, the MICOM 30 determines the environmental intensity of illumination based on the sensed result of the sensor for an environmental intensity of illumination at operation 102. If determined that the environmental intensity of illumination is low, the MICOM 30 outputs a PWM signal having a decreased duty ratio to the inverter 14 to decrease the intensity of illumination of the back light 12 at operation 104. If determined that the environmental intensity of illumination is high, the MICOM 30 outputs a PWM signal having an increased duty ratio to the inverter 14 to increase the intensity of illumination of the back light 12 at operation 106.

FIG. 5 is a control flow chart of a display according to a second embodiment of the present invention.

If a brightness adjusting function selecting signal for the back light 12 according to a brightness distribution data is input at operation 120, the MICOM 30 determines the lightness of the inputted video signal based on the detected result of the brightness distribution data detector 18 at operation 122. If determined that the inputted video signal is dark, the MICOM 30 controls the contrast intensifier 16 to decrease a contrast intensifying

gain and the inverter 14 to decrease the intensity of illumination of the back light 12 at operation 124. If determined that the inputted video signal is light, the MICOM 30 controls the contrast intensifier 16 to increase a contrast intensifying gain and the inverter 14 to decrease the intensity of illumination of the back light 12 to a predetermined level at operation 126, thereby providing the most suitable image. To detailed adjust the intensity of illumination of the back light 12, the PWM dimming method is preferably used.

In the above embodiments, only one of the environmental intensity of illumination and the brightness distribution data is considered to adjust the lightness of the back light 12. However, both of the environmental intensity of illumination and the brightness distribution data may be considered to adjust the lightness of the back light 12.

If determined that the inputted video signal is dark based on the brightness distribution data detected by the brightness distribution data detector 18, the MICOM 30 may control the inverter 14 to decrease the intensity of the illumination of the back light 12. If determined that the inputted video signal is light, the MICOM 30 may control the inverter 14 to increase the intensity of the illumination of the back light 12.

In the above embodiments, the brightness distribution

data detector 18 detects brightness distribution data of the inputted video signal after the signal of intensified contrast is input by the contrast intensifier 16. However, the contrast intensifier 16 intensifies the contrast of the video signal passing through the brightness distribution data detector 18.

According to the invention, the intensity of illumination of the back light is automatically adjusted according to the brightness of one of the environmental intensity of illumination and brightness distribution data of an inputted video signal as the selection of the user. Thus, the visual fatigue of a user is decreased and the contrast of light and darkness is increased, thereby providing a more suitable image.

As described above, the present invention provides the display in which the intensity of illumination of the back light is automatically adjusted according to at least one of the environmental intensity of illumination and the brightness distribution data of the inputted video signal as a selection of a user to provide the most suitable image and control method thereof.

Although a few embodiments of the present invention have been shown and described, it will be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the principles and spirit of the invention, the scope of which is defined in

the claims and their equivalents.

CLAIMS

What is claimed is:

1. A display comprising:

a liquid crystal display panel;

a back light to illuminate the liquid crystal display panel;

an inverter to supply electric power to the back light and adjust an intensity of illumination of the back light;

a selector to select a function to adjust the intensity of illumination of the back light according to at least one of an environmental intensity of illumination and a brightness distribution data of an inputted video signal;

a brightness distribution data detector to detect the brightness distribution data of the inputted video signal;

a sensor to sense the environmental intensity of illumination; and

a controller to determine a lightness of an image based on at least one of the environmental intensity of illumination sensed by the sensor for an environmental intensity of illumination and the brightness distribution data detected by the brightness distribution data detector according to a selection through the selector and to control the inverter to adjust the intensity of illumination of the back light according to the determined lightness.

2. The display according to claim 1, further

comprising a contrast intensifier to intensify a contrast of the inputted video signal to a predetermined gain and to supply the intensified contrast to the brightness distribution data detector.

3. The display according to claim 2, wherein the controller controls the contrast intensifier to decrease a contrast gain and controls the inverter to decrease the intensity of illumination of the back light if the inputted video signal is dark based on the brightness distribution data, and

the controller controls the contrast intensifier to increase the contrast gain and controls the inverter to decrease the intensity of illumination of the back light to a predetermined level if the inputted video signal is bright.

4. The display according to claim 1, wherein the controller controls the inverter to decrease the intensity of illumination of the back light if the environmental intensity of illumination is low, and

the controller controls the inverter to increase the intensity of illumination of the back light if the environmental intensity of illumination is high.

5. The display according to claim 2, wherein the controller controls the inverter to decrease the intensity of illumination of the back light if the environmental intensity of illumination is low, and,

the controller controls the inverter to increase the intensity of illumination of the back light if the environmental intensity of illumination is high.

6. The display according to claim 3, wherein the controller controls the inverter to decrease the intensity of illumination of the back light if the environmental intensity of illumination is low, and,

the controller controls the inverter to increase the intensity of illumination of the back light if the environmental intensity of illumination is high.

7. The display according to claim 1, wherein the controller controls the inverter to decrease the intensity of illumination of the back light if the inputted video signal is dark based on the brightness distribution data, and

the controller controls the inverter to increase the intensity of illumination of the back light if the inputted video signal is light.

8. A control method of a display including a liquid crystal display panel, a back light to illuminate the LCD panel, an inverter to supply electric power to the back light and adjust an intensity of illumination of the back light, the control method of the display comprising:

sensing an environmental intensity of illumination;

detecting a brightness distribution data of an inputted video signal;

determining lightness of an image based on at least one of the sensed environmental intensity of illumination and the detected brightness distribution data of the inputted video signal when a user selects a function to adjust the intensity of illumination of the back light according to the at least one of the environmental intensity of illumination and the brightness distribution data of the inputted video signal; and

controlling the inverter to adjust the intensity of the illumination of the back light according to the determined lightness.

9. The control method of a display according to claim 8, further comprising detecting the brightness distribution data after intensifying a contrast of the inputted video signal to a predetermined gain.

10. The control method of a display according to claim 9 further comprising:

decreasing a contrast intensifying gain and decreasing the intensity of illumination of the back light if the inputted video signal is dark based on the detected brightness distribution data; and

increasing the contrast intensifying gain and decreasing the intensity of illumination of the back light to a predetermined level if the inputted video signal is light based on the detected brightness distribution data.

11. The control method of a display according to claim 8, further comprising:

controlling the inverter to decrease the intensity of illumination of the back light if the environmental intensity of illumination is low and controlling the inverter to increase the intensity of illumination of the back light if the environmental intensity of illumination is high.

12. The control method of a display according to claim 9, further comprising:

controlling the inverter to decrease the intensity of illumination of the back light if the environmental intensity of illumination is low and controlling the inverter to increase the intensity of illumination of the back light if the environmental intensity of illumination is high.

13. The control method of a display according to claim 10, further comprising:

controlling the inverter to decrease the intensity of illumination of the back light if the environmental intensity of illumination is low and controlling the inverter to increase the intensity of illumination of the back light if the environmental intensity of illumination is high.

14. The control method of a display according to claim 8 further comprising:

controlling the inverter to decrease the intensity of illumination of the back light if the inputted video signal is dark based on the detected brightness distribution data and controlling the inverter to increase the intensity of illumination of the back light if the inputted video signal is light.

15. A display apparatus for automatically adjusting an intensity of illumination of a back light, comprising:

an inverter inverting direct current to alternating current to supply power to the back light;

a sensor sensing an environmental intensity of illumination;

a contrast intensifier intensifying a contrast of the inputted video signals;

a brightness detector detecting brightness distribution data of the inputted video signals of intensified contrast; and

a controller receiving the sensed environmental intensity of illumination or the detected brightness distribution data and outputting analog signals or pulse width modulation signals to the inverter to increase or decrease the intensity of illumination of the back light, wherein duty ratios of the pulse width modulation signals and voltages of the analog signals vary as the environmental intensity of illumination or the brightness distribution data.

16. The display apparatus of claim 15, wherein the controller outputs pulse modulation signals having a decreased duty ratio to decrease the intensity of illumination of the back light if the environmental intensity of illumination is low.

17. The display apparatus of 15, wherein the controller outputs pulse modulation signals having an increased duty ratio to increase the intensity of illumination of the back light if the environmental intensity of illumination is high.

18. The display apparatus of claim 15, wherein the controller controls the contrast intensifier to decrease a contrast intensifying gain and controls the inverter to decrease the intensity of illumination of the back light if an image is dark based on the detected brightness distribution data.

19. The display apparatus of claim 15, wherein the controller controls the contrast intensifier to increase a contrast intensifying gain and controls the inverter to decrease the intensity of illumination of the back light to a predetermined level if an image is light based on the detected brightness distribution data.

20. The display apparatus of claim 15, further comprising a selector to select a function to adjust the intensity of illumination of the back light according to at least one of the environmental intensity of illumination,

the brightness distribution data.

21. The display apparatus of claim 15, wherein the contrast intensifier sets low and high levels of the inputted video signals and intensifies the contrast by applying a predetermined gain within the low and high levels.

22. A method of automatically adjusting an intensity of illumination of a back light on a display device, comprising:

selecting a function to automatically adjust the intensity of illumination of the back light according to an environmental intensity of illumination; and

decreasing the intensity of illumination of the back light if the environmental intensity of illumination is low and increasing the intensity of illumination of the back light if the environmental intensity of illumination is high.

23. A method of automatically adjusting an intensity of illumination of a back light on a display device, comprising:

selecting a function to automatically adjust the intensity of illumination of the back light according to a level of brightness; and

decreasing a contrast intensifying gain and decreasing the intensity of illumination of the back light if an image is dark based on brightness distribution data and

increasing the contrast intensifying gain and decreasing the intensity of illumination of back light if the image is light based on the brightness distribution data.

24. A method of automatically adjusting an intensity of illumination of a back light on a display device, comprising:

selecting a function to automatically adjust the intensity of illumination of the back light according to at least one of an environmental intensity of illumination and brightness distribution data of inputted video signals;

sensing an environmental intensity of illumination to determine if the environmental intensity of illumination is low or high based on a predetermined value, and correspondingly decreasing the intensity of illumination of the back light if the environmental intensity of illumination is low and increasing the intensity of illumination of the back light if the environmental intensity of illumination is high; and

detecting a brightness level of intensified contrast signals to determine if an image is dark or light based on brightness distribution data and correspondingly decreasing a contrast intensifying gain and decreasing an intensity of illumination of the back light if the image is dark and increasing the contrast intensifying gain and decreasing the intensity of illumination of back light if the image is light.

25. The method of claim24, further comprising intensifying the contrast of inputted video signals by applying a predetermined gain corresponding to set low and high levels of the inputted video signals.

26. The method of claim24, further comprising outputting pulse width modulation signals having a decreased duty ratio to decrease the intensity of illumination of the back light if the environmental intensity of illumination is low.

27. The method of claim24, further comprising outputting pulse width modulation signals having an increased duty ratio to increase the intensity of illumination of the back light if the environmental intensity of illumination is high.

28. The method of claim24, wherein the detecting brightness distribution data is performed after intensifying the contrast of the inputted video signals.

29. A method of automatically adjusting an intensity of illumination of a back light on a display device, comprising automatically adjusting the intensity of illumination of the back light according to a brightness level of at least one of an environmental intensity of illumination and brightness distribution data of inputted video signals.

FIG. 1

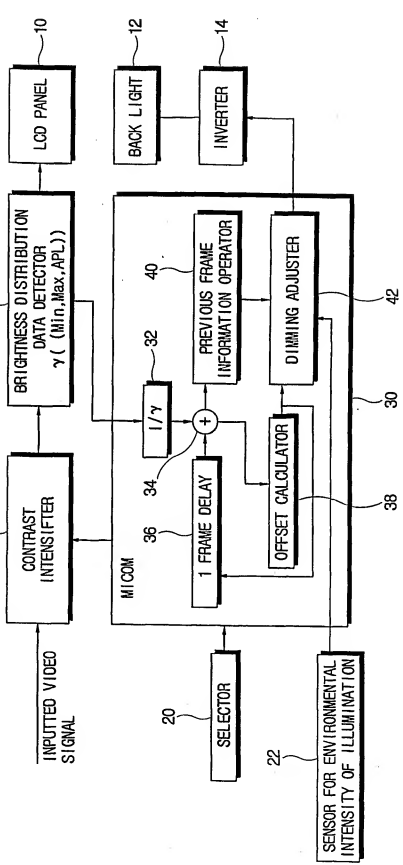

LCD PANEL
10
BACK LIGHT
12
INVERTER
14
BRIGHTNESS DISTRIBUTION DATA DETECTOR γ((Min,Max,APL))
18
CONTRAST INTENSIFIER
16
MICOM
1/γ
32
PREVIOUS FRAME INFORMATION OPERATOR
40
DIMMING ADJUSTER
42
1 FRAME DELAY
36
OFFSET CALCULATOR
38
34
30
INPUTTED VIDEO SIGNAL
SELECTOR
20
SENSOR FOR ENVIRONMENTAL INTENSITY OF ILLUMINATION
22

FIG. 2

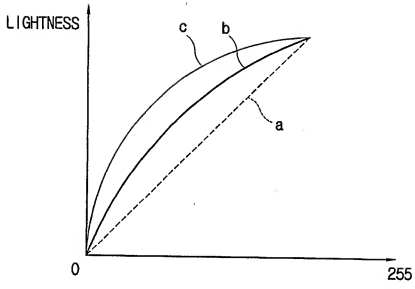


FIG. 3

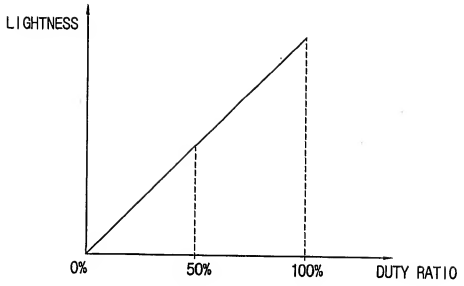


FIG. 4

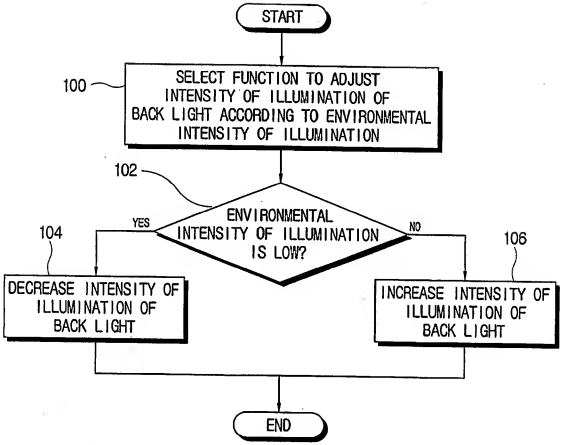
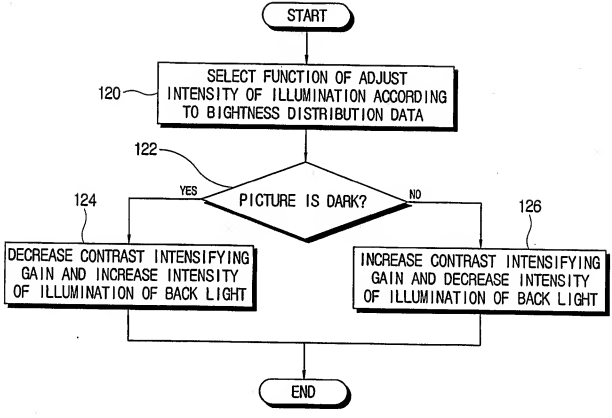

START
100
SELECT FUNCTION TO ADJUST INTENSITY OF ILLUMINATION OF BACK LIGHT ACCORDING TO ENVIRONMENTAL INTENSITY OF ILLUMINATION
102
ENVIRONMENTAL INTENSITY OF ILLUMINATION IS LOW?
YES
NO
104
DECREASE INTENSITY OF ILLUMINATION OF BACK LIGHT
106
INCREASE INTENSITY OF ILLUMINATION OF BACK LIGHT
END

FIG. 5


START
SELECT FUNCTION OF ADJUST INTENSITY OF ILLUMINATION ACCORDING TO BIGHTNESS DISTRIBUTION DATA
120
122
PICTURE IS DARK?
YES
NO
124
126
DECREASE CONTRAST INTENSIFYING GAIN AND INCREASE INTENSITY OF ILLUMINATION OF BACK LIGHT
INCREASE CONTRAST INTENSIFYING GAIN AND DECREASE INTENSITY OF ILLUMINATION OF BACK LIGHT
END

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2004/001713

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 G02F 1/133

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC7 G02F, G09G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Patents and applications for inventions since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
NPS: "sensor", "detect", "adaptive", "backlight"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5818553 A (Norand Corporation) 6 October 1998 *see the whole document*	1, 4, 22, 29
A	US 5786801 A (Sony Corporation) 28 July 1998 *see the whole document*	1, 4, 22, 29
A	US 6144359 A (Rockwell Science Center) 7 November 2000 *see the whole document*	1, 4, 22, 29
A	WO 02/42837 A1 (Siemens) 30 May 2002 *see the whole document*	1, 4, 22, 29
A	WO 93/23842 A1 (Motorola, Inc.) 25 November 1993 *see the whole document*	1, 4, 22, 29
A	JP 10-20277 A (Matsushita Electric Ind. Co. Ltd.) 23 January 1998 *see the whole document*	1, 4, 22, 29

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance
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"&", document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 OCTOBER 2004 (22.10.2004)	**22 OCTOBER 2004 (22.10.2004)**
Name and mailing address of the ISA/KR Korean Intellectual Property Office 920 Dunsan-dong, Seo-gu, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer KOH, Jong Wook Telephone No. 82-42-481-5989

Form PCT/ISA/210 (second sheet) (January 2004)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
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